

# THE NON - METALS - II

## NITROGEN PHOSPHORUS AND HALOGENS



राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्  
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## PREFACE

The present series of twelve chemistry units has been developed for try-out of the Individually Guided System of Instruction (IGSI) in class IX. The description of IGSI and first two units of this series of units are available under a separate cover. This new system of instruction and the units have been developed along the lines of the National Policy on Education (NPE-86) and involve the participation of pupils in the process of learning. The units are suited for self-study with occasional help from a tutor. In the present context, these units will serve as exemplar self-study material for secondary stage chemistry. In developing this unit, I was assisted by some of the chemistry teachers.

This unit contains an introduction for motivation, arousing interest, and to link the present unit with preceeding and next units. The objectives given in this unit are the expected learning outcomes, so that the pupil will know the ultimate goals he has to achieve. The suggested reading material provided in the unit guides the pupil to achieve pre-stated objectives. A number of intext and post-text questions, activities, and problems have been included to provide enough practice and chance for self evaluation.

The suggestions for the improvement of this unit will be welcomed.

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June, 1988



## I. Introduction

In the previous unit, we have studied about non-metals, hydrogen, oxygen and sulphur and their compounds. In this unit, we shall study about some more non-metals and their compounds.

We know that air contains about 78% nitrogen (by volume). The presence of this large quantity of nitrogen reduces the intense reactivity of oxygen present in the atmosphere. Had there been no nitrogen in the atmosphere, any fire once started would never have come to an end as oxygen is a supporter of combustion.

Because of the continuous growth of population, the demand for food grains is on the increase. To enhance the agricultural production, chemical substances are added to the soil. These substances, known as chemical fertilizers, are compounds of nitrogen and phosphorus. These two elements, namely nitrogen and phosphorus, are also present in the bodies of living beings. Nitrogen is present in the form of proteins. Phosphorus is present in bones, teeth, brain and muscle tissues.

The elements fluorine, chlorine, bromine, iodine and astatine are known as halogens. These are named halogens because chlorine, bromine and iodine are found in the form of salts present in sea water (Halo—sea salts, gene—born). Halogens form many important compounds. We are well familiar with common salt. It forms an essential ingredient of our food. It is a salt of sodium and chlorine. Chlorine as such is used extensively for purifying drinking water. All of us are fond of getting our photographs. The film used for photography is prepared using silver bromide, a salt of silver and bromine.

In this unit, we shall study about the elements nitrogen, phosphorus and halogens and their important compounds.

## II. Objectives

After completing this unit, you should be able to

1. Locate the position of nitrogen, phosphorus and halogens in the periodic table.
2. Describe the properties, reactions and uses of nitrogen
3. Describe the preparation of ammonia gas with a labelled diagram, its properties and uses.
4. Describe the principle of manufacture, reactions and uses of nitric acid.
5. Describe the occurrence, allotropic forms, reactions and uses of phosphorus.
6. Define the term fertilizer and name some important nitrogenous and phosphatic fertilizers.
7. Describe the occurrence of halogens.
8. Describe the preparations, properties and uses of chlorine gas.
9. Describe the preparation, properties and uses of hydrogen chloride.
10. Distinguish between chloride, bromide and iodide.
11. Identify three mineral acids, HCl,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ .

## III. Suggested reading material

### 10.1 NITROGEN

#### Position in the periodic table

Nitrogen and phosphorus are present in group VA of the periodic table. They have five electrons each in their outermost shell.

**Occurrence :** Nitrogen is present in nature both in free as well as in combined states. In free state it is present as nitrogen gas in the atmosphere. In combined state it is present in the form of nitrates, ammonium salts and proteins.

## Physical properties

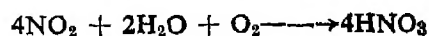
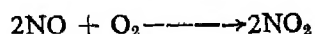
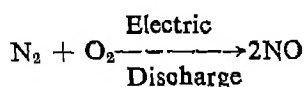
Nitrogen is a colourless and odourless gas, very slightly soluble in water and lighter than air.

PERIOD 1	H				
		GROUP IV	GROUP V	GROUP VI	GROUP VII
PERIOD 2		C	N	O	F
PERIOD 3			P	S	Cl
PERIOD 4				Se	Br
PERIOD 5					I

Fig. 10.1 Position of nitrogen and phosphorus in Periodic Table.

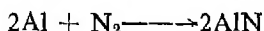
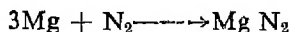
## Chemical Properties

1. Nitrogen is a less active gas and does not combine with other elements easily (combines only under special conditions).
2. When high voltage electric discharge is passed through nitrogen, it combines with oxygen of air to form nitric oxide. Nitric oxide is unstable and combines with more oxygen and changes into nitrogen dioxide. Nitrogen dioxide dissolves in water to form nitric acid.

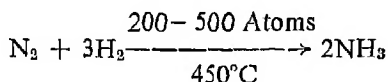


These reactions also take place in nature during lightening. However at room temperature, nitrogen does not react with oxygen.

3. Nitrogen is non-combustible and also non-supporter of combustion. But if a burning piece of active metal like magnesium is taken into a gas jar full of nitrogen, it continues and a white powdery substance is formed.



4. Nitrogen combines with hydrogen at high pressure and high temperature in the presence of catalyst.



### 10.14 Uses of nitrogen

1. Due to its inert nature, nitrogen is used in place of air wherever inert atmosphere is required e.g. in many industrial processes.
2. Nitrogen is used in the manufacture of ammonia gas, nitric acid and nitrogenous fertilizers.

### Questions

1. Does sea water contain free nitrogen?
2. Nitrogen is a non-supporter of combustion, still aluminium and magnesium burn in an atmosphere of nitrogen. Give the products of combustion and write chemical equations of reactions involved.
3. What happens when an electric discharge at high voltage is passed through air? Which important product can be obtained by the above reactions?

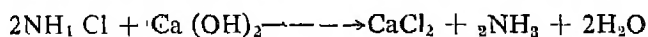
### 10.2 AMMONIA

Molecular Formula :  $\text{NH}_3$

Molecular Mass : 17



**Laboratory Preparation :** In the laboratory, ammonia gas can be prepared by heating a mixture of ammonium chloride and calcium hydroxide in a boiling tube according to the following reaction :—



The gas being lighter than air, is collected by downward displacement of air.

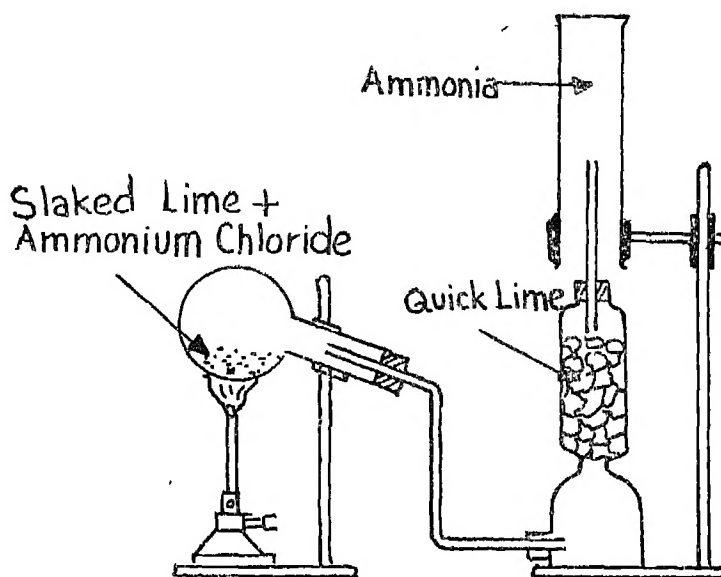
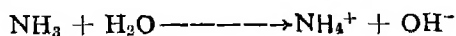


Fig. 10.2 Preparation of ammonia.

### 10.21 Chemical Reactions

1. Ammonia is highly soluble in water and the solution is basic in nature.



You can understand this property clearly by the following experiment known as fountain Experiment.

#### Fountain Experiment

A flask fitted with a tight rubber cork having two holes is taken. It is filled with ammonia gas. Through one hole, a dropper filled with

water is passed and through the other hole passes glass tube with jet end in the flask. The other end dips in red litmus solution as shown the figure 10.3.

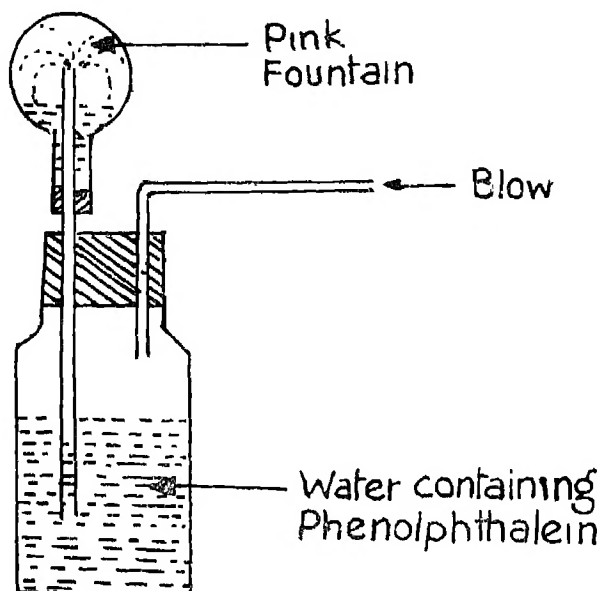
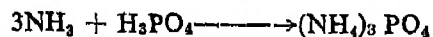
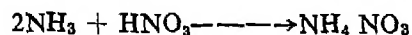


Fig. 10.3 Fountain experiment

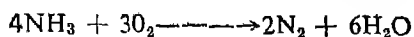
When the dropper bulb is pressed, water enters in the flask and dissolves ammonia. So the gas pressure is reduced and red litmus is sucked inside the flask in the form of fine stream. The colour of litmus solution changes from red to blue because of basic nature of ammonia.

- Basic nature :** Because of basic nature, ammonia reacts with acids and forms corresponding salts.

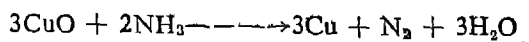


3. **Oxidation** : Ammonia is oxidised to nitrogen and nitric oxide under different conditions.

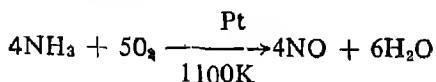
(i) When it is burnt in excess of oxygen, it forms nitrogen.



(ii) When ammonia is passed over heated copper oxide as catalyst, it is oxidised to  $\text{N}_2$ .

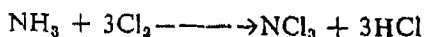


(iii) When ammonia is passed over heated platinum, it is oxidised to nitric oxide



(iv) **Reaction with chlorine**

(i) Ammonia reacts with chlorine (excess) to produce nitrogen trichloride.



### Uses of Ammonia

1. Ammonia is used in the manufacture of nitrogenous fertilizers like urea, ammonium nitrate, ammonium sulphate and ammonium phosphate
2. Ammonia is used in the manufacture of nitric acid.
3. It is used for preparing sodium carbonate by solvay process.
4. It is used as a refrigerant in cold storage and ice plants.

### Questions

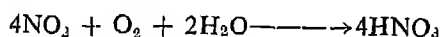
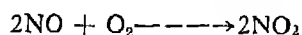
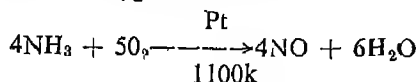
1. Name some nitrogenous fertilizers.
2. Name some useful compounds which can be obtained from ammonia.

### 10.3 NITRIC ACID

Nitric acid is a mineral acid. It is used in the laboratory as a chemical reagent. It also finds a number of applications in industries.

#### 10.31 Manufacture

**Principle :** Nitric acid is prepared on a large scale by catalytic oxidation of ammonia. A mixture of ammonia and air is heated and passed over platinum catalyst when nitric oxide is obtained. This is further oxidised to nitrogen dioxide which on dissolving in water in presence of oxygen gives nitric acid.



This process is known as Ostwald's Process.

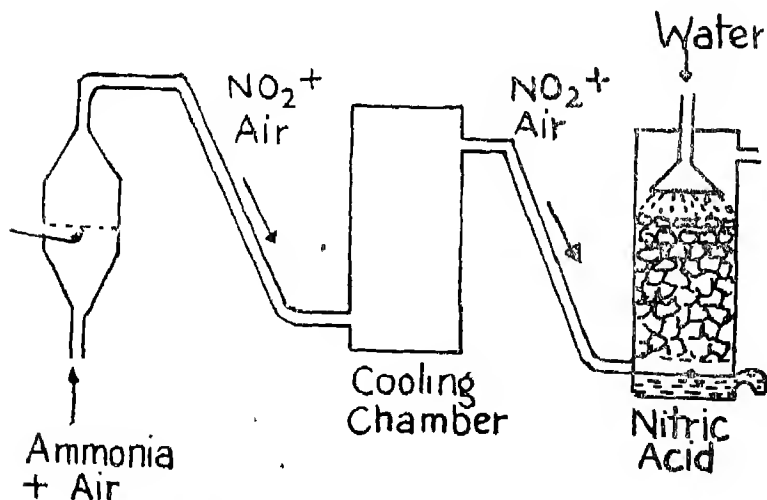


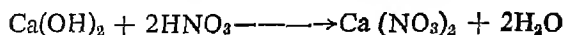
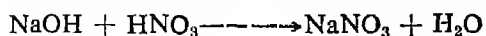
Fig. 10.4 Manufacture of nitric acid.

#### 10.32 Reactions

Nitric acid behaves in two ways..

- (i) As an acid
- (ii) As an oxidising agent.

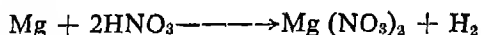
- I. **As an Acid** : Nitric acid acts as a very strong acid. It reacts with alkalis and carbonates forming nitrates.



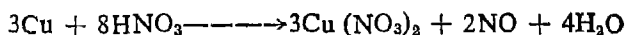
### Reaction with metals

Different metals liberate either Oxides of nitrogen or hydrogen from nitric acid under different conditions e.g.

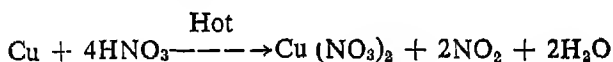
- (a) Magnesium displaces hydrogen when it reacts with dilute nitric acid



- (b) Copper reacts with cold dilute nitric acid, to produce nitric oxide.

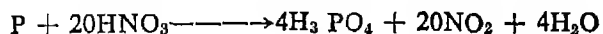


- (c) When copper reacts with hot concentrated nitric acid, nitrogen dioxide is liberated

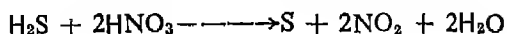
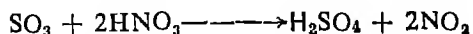


### II. As an oxidising agent

- (i) Nitric acid oxidises non-metals to their corresponding acids, e.g.



- (ii) Nitric acid oxidises compounds like  $\text{SO}_2$  and  $\text{H}_2\text{S}$



### Questions

1. Write the principle of manufacture of nitric acid starting from ammonia. Also write the name of the process.

2. How does copper react with nitric acid ? Give equations
3. What happens when magnesium reacts with dilute nitric acid ?
4. What happens when  $\text{H}_2\text{S}$  gas is passed through  $\text{HNO}_3$  ?
5. Name two explosives which can be prepared from nitric acid.
6. Name four compounds which can be manufactured from nitric acid

### Uses

1. Nitric acid is an important laboratory reagent.
2. Nitric is used in manufacture of explosives such as nitroglycerine, trinitrotoluene, picric acid etc.
3. It is used in the manufacture of dyestuffs.
4. It is used in the manufacture of nitrates which are used as fertilizers.

## 10.4 PHOSPHORUS

*Occurrence* : You have already read about the occurrence of phosphorus in the introduction.

*Allotropes of Phosphorus* : Phosphorus exists in two allotropic forms.

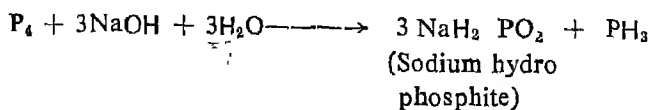
- (i) White or yellow phosphorus
- (ii) Red Phosphorus

### Reactions of phosphorus

Phosphorus is an active element and easily combines with other elements. White phosphorus reacts more vigorously as compared to red phosphorus.

1. White phosphorus undergoes slow oxidation and glows in the dark. This property of glowing of phosphorus is known as *phosphorescence*.
2. **Reaction with sodium hydroxide**

White phosphorus dissolves in sodium hydroxide on boiling and forms phosphine.

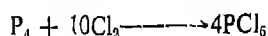


The reactions common to both white and red phosphorus are as follows :

1. Combustion :- Phosphorus burns in oxygen to give phosphorus pentoxide



2. Phosphorus reacts with chlorine to form tri and penta chloride.



### Uses of Phosphorus

1. Phosphorus is used in manufacturing phosphoric acid which is further utilized in preparing phosphatic fertilizers eg. calcium superphosphate.
2. Red phosphorus finds use in match industry.
3. Red phosphorus is used as rat poison.
4. Compounds of phosphorus are used in making smoke screens.

### Questions

1. What happens when phosphorus is burnt in air ?
2. Why is white phosphorus kept under water ?
3. Name one important phosphatic fertilizer.

### 10.5 Halogens

As we know, the elements fluorine, chlorine, bromine and iodine are collectively called 'halogens'. These elements have strong tendency to form salts with metals. The salts of halogens are called halides. Table-10.1 gives some information about halogens.

Table 10.1

Element	Atomic number	symbol	Molecular formula	Physical state	colour
Fluorine	9	F	F <sub>2</sub>	Gas	Pale-yellow
chlorine	17	Cl	Cl <sub>2</sub>	Gas	Greenish yellow
Bromine	35	Br	Br <sub>2</sub>	Liquid	Reddish Brown
Iodine	53	I	I <sub>2</sub>	Solid	Violet

## Position in the periodic table

Electronic configurations of fluorine and chlorine are as follows :

F=2,7

Cl=2,8,7

All the halogens contain '7' electrons in the outermost shells of their atoms. So they have been placed in Group-VII of the periodic table which is just before the zero group elements (noble gases).

1. Why have the halogens been given this name ?
2. How do you justify the placement of halogens in 7th group of the periodic table ?

*High Reactivity* As you have studied in unit 5, the elements react with other elements so as to acquire an 'octet' of electrons in their outermost shell. The halogens need just one electron to complete their octet. Because of this strong tendency to gain one electron, halogens are highly reactive.

## Occurrence

Due to their high reactivity, halogens are not found in free state (in the form of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ) in nature. They are found only in the form of their salts. Fluorine occurs in the form of cryolite -  $Na_2 AlF_6$  and fluorspar -  $CaF_2$ . Chlorine occurs in the form of metal chlorides. Most abundant of these is sodium chloride (the common salt) found in rock salt and sea water. Bromine is found in small amounts in sea water in the form of bromides of sodium, potassium and magnesium. Iodine is the least abundant halogen. Traces of iodides are found in sea-water.

## Questions

3. Why are halogens' not found free in nature ?
4. Name one naturally occurring compound each of fluorine and chlorine.

## 10.6 Chlorine

Symbol — Cl

Atomic mass = 35.5

Molecular formula :  $Cl_2$

molecular mass = 71



### Laboratory Preparation

Chlorine gas is prepared in the laboratory by heating a mixture of manganese dioxide and concentrated hydrochloric acid.

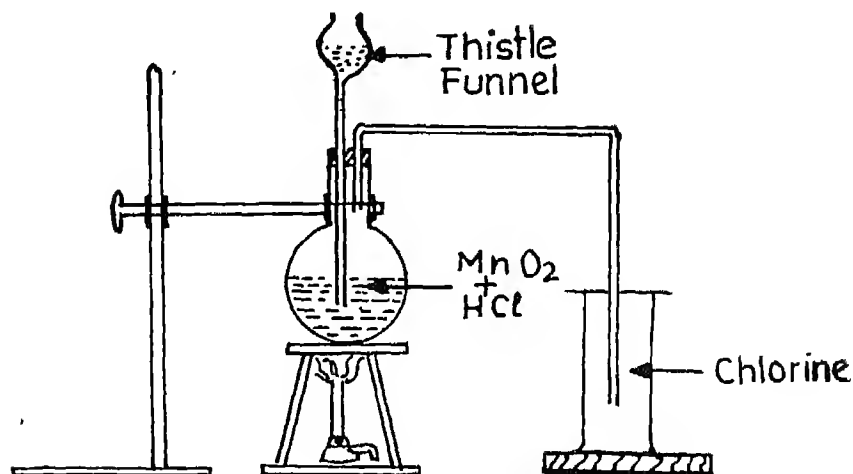
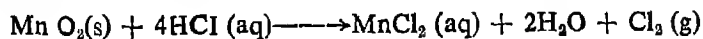


Fig. 10.5 Preparation of chlorine in the laboratory.

Some manganese dioxide is taken in a round bottom flask. The apparatus is fitted as shown in the figure. Concentrated hydrochloric acid is poured through the thistle funnel and the flask is heated. Chlorine, a greenish-yellow coloured gas, is collected in the gas jar by upward displacement of air.

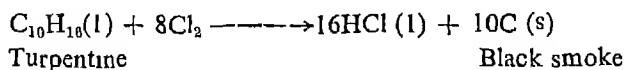
### Physical properties

Chlorine is a greenish-yellow gas with a pungent suffocating odour. It is heavier than air. Therefore it is collected by upward displacement of air. It is poisonous in nature. On passing the gas into water for sometime, a yellowish green solution is obtained showing that chlorine is fairly soluble in water. The solution of chlorine in water is called chlorine water.

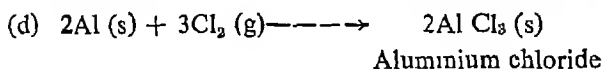
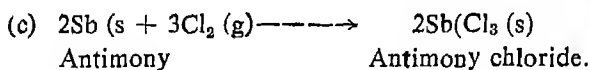
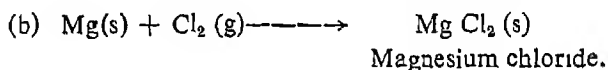
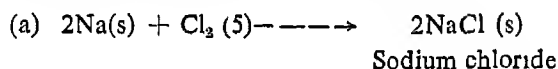
## Chemical Properties

- (i) *Acidic nature*: A moist blue litmus paper, when dipped in a jar of chlorine gas turns red. This shows that chlorine is acidic in nature.
- (ii) *Combustion*: If a burning candle is brought in a jar of chlorine gas, it continues to burn with a smoky flame. Thus chlorine is not combustible (does not burn) but is a supporter of combustion.

Similarly when a filter paper soaked in turpentine oil is inserted in a jar full of chlorine gas, it catches fire producing a dense black residue of carbon.

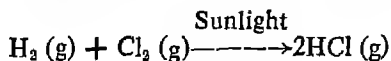


- (iii) *Reaction with metals*: Chlorine reacts with heated metals forming metal chlorides. For example,

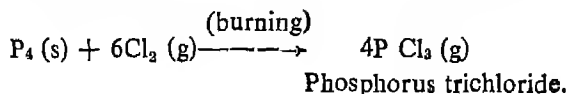


- (iv) **Reaction with non-metals**

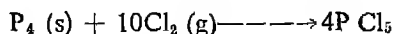
- (a) *Reaction with hydrogen*: Chlorine reacts violently with hydrogen in the presence of sunlight forming hydrogen chloride.



*Reaction with phosphorus*: Chlorine forms chlorides with Phosphorus

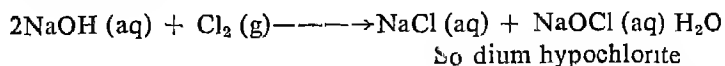


If chlorine is in excess, the Product is Phosphorus pentachloride.



(v) **Reaction with alkalis**

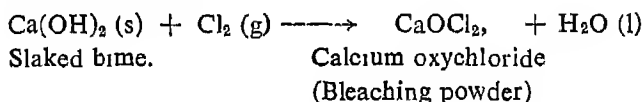
- (a) *With cold and dilute alkali* :- Chlorine reacts with cold solution of dilute sodium hydroxide and gives a mixture of chloride and hypochlorite.



- (b) *With hot & concentrated alkali* :- When chlorine is passed through a hot and concentrated sodium hydroxide solution, a mixture containing chloride and chlorate is obtained.



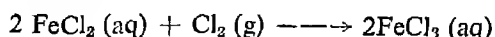
- (c) *With slaked lime* [ $Ca(OH)_2$ ] : When chlorine is passed over dry slaked lime for a considerable length of time, bleaching powder is formed.



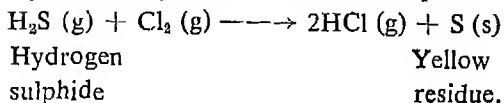
Bleaching powder is used for bleaching (discharging the colour) paper and wood pulp.

- (vi) **Oxidising action** : Chlorine acts as an oxidising agent as shown by the following reactions

- (i) Iron (II) (ferrous) chloride is oxidised to iron (III) (ferric) chloride.

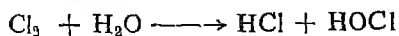


- (ii) Hydrogen sulphide is oxidised to sulphur.

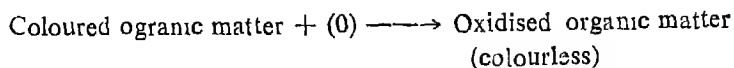
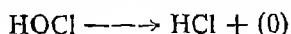


- iii) **Bleaching action** : If a moist coloured flower is put in a jar of chlorine gas, it becomes colourless. We can say that it is bleached. Bleaching of colour is not observed if

the flower is dry. This shows that chlorine acts as a bleaching agent in the presence of water or moisture only. Its bleaching action is explained as follows :

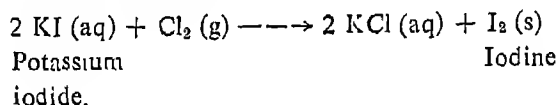
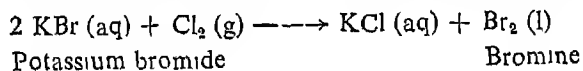


Hypochlorous acid decomposes to give nascent (new born) oxygen which bleaches the coloured organic matter.



As chlorine bleaches the coloured material by oxidation, so bleaching of materials by chlorine is permanent.

(viii) *Reaction with bromides and iodides* : Chlorine displaces bromine and iodine from bromide and iodide solutions respectively.



These displacement reactions show that chlorine is more reactive than bromine and iodine.

### Questions

- 1 Why is chlorine collected by upward displacement of air ?
2. How will you show that chlorine is acidic in nature?
- 3 Give balanced chemical equations for the reactions of chlorine with the following :
  - (i) Hot and concentrated sodium hydroxide
  - (ii) Phosphorus
  - (iii) Burning ribbon of magnesium
  - (iv) Slaked lime.

4. How will you show the bleaching action of chlorine?
5. How will you show that chlorine is more reactive than bromine?

#### Uses of chlorine

1. Chlorine is used for the manufacture of bleaching powder.
2. Chlorine is added to city water to make it potable as it kills germs (germicide). Chlorine is used as a raw material in the manufacture of P V C (poly vinyl chloride)
3. P.V.C is a plastic. It is used for making rain coats, hand bags, plastic dolls etc.
4. Chlorine is used for the preparation of important antiseptics and insecticides like B H C. (Benzene hexachloride) and D.D.T
5. Compounds like Phosgene and mustard gas which are used in chemical warfare, contain chlorine in their constitution.

#### Questions

1. List two main uses of chlorine.
2. Why is chlorine used for sterilizing drinking water ?
3. Name two compounds of chlorine used in chemical warfare.

#### 10.7 Hydrogen Chloride

Molecular formula —  $\text{HCl}$

Molecular mass — 36.5

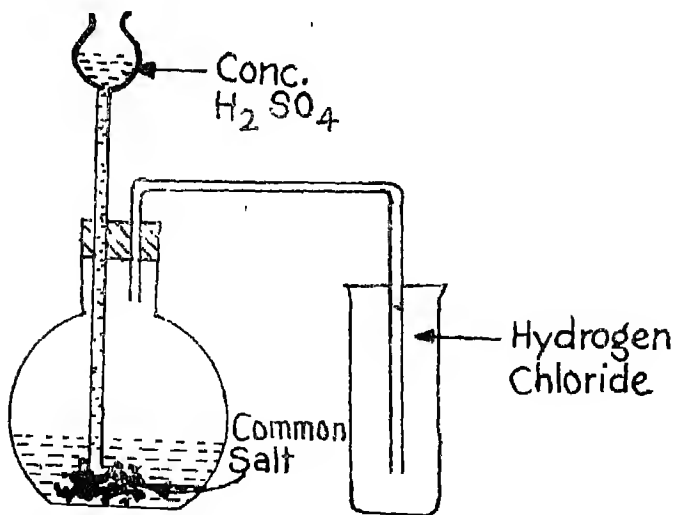
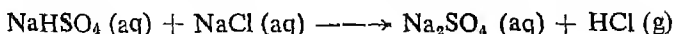
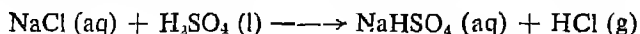


Fig. 10.6 Preparation of hydrogen chloride

## Laboratory Preparation

Hydrogen chloride gas is prepared in the laboratory by the action of concentrated sulphuric acid on sodium chloride (common salt).



## Preparation of hydrogen chloride gas

Powdered common salt is taken in a flat bottom flask and the apparatus fitted as shown in the figure. Sulphuric acid is poured through the thistle funnel. Hydrogen chloride gas is collected by upward displacement of air. It is not collected under-water as it is soluble in water

## Physical properties

Hydrogen chloride is a colourless gas with pungent smell. It is heavier than air. It is highly soluble in water. The solution of hydrogen chloride gas in water is called hydrochloric acid.

High solubility of hydrogen chloride can be demonstrated by a simple experiment known as fountain experiment

## Fountain Experiment

A dry round-bottom flask filled with hydrogen chloride gas is fitted with a jet tube. The apparatus is fitted as shown in figure 10.3. Lower end of the jet tube is dipped inside water to which a few drops of blue litmus are added. Air is blown through the bent tube so that water is forced up through the jet tube into the flask.

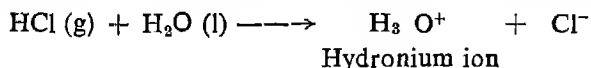
This small volume of water dissolves some of the gas to create a partial vacuum. Because of this vacuum, blue litmus solution is forced to rush into the flask in the form of a red coloured fountain. This process continues till whole of the gas is dissolved.

Turning of blue litmus solution to red also indicates that hydrogen chloride is acidic.

## Chemical Properties

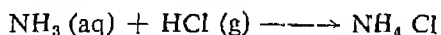
1. **Acidic nature :** A moist blue litmus paper turns red in a jar of hydrogen chloride showing acidic nature of the gas.

The solution of hydrogen chloride in water i.e. hydrochloric acid is a strong acid. It ionises to give hydronium ions and chloride ions.

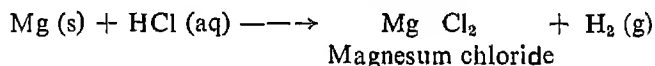
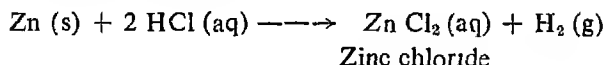


Hydronium ions are responsible for acidic nature of hydrochloric acid.

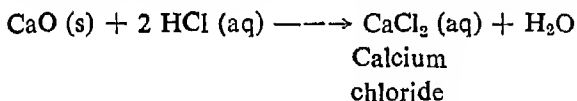
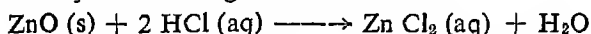
- Reaction with ammonia :** A glass rod dipped in aqueous ammonia when brought in contact with hydrogen chloride gives dense white fumes of ammonium chloride.



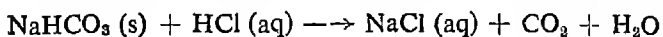
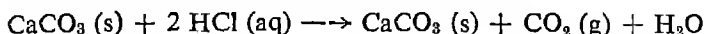
- Reaction with metals :** Hydrochloric acid reacts with some metals liberating hydrogen gas. The reactions with zinc and magnesium are shown as follows :



- Reaction with bases :** Hydrochloric acid neutralizes basic oxides and hydroxides to give salt and water.



- Reaction with carbonates :** Hydrochloric acid liberates carbon dioxide from carbonates and bicarbonates.



- Reaction with nitric acid :** A mixture containing three parts by volume of concentrated hydrochloric acid and one part of concentrated nitric acid is called *aqua regia*. This is used to dissolve gold.

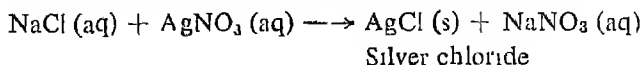
### Question

Give two important uses of hydrochloric acid.

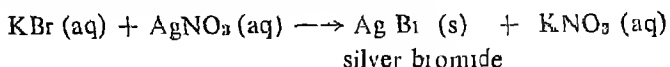
## Test for halides

(1) Silver nitrate test :- If silver nitrate is added to halide solution, then

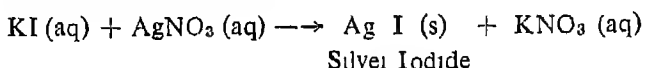
- (i) chloride gives dense white precipitate of silver chloride. The precipitate is soluble in ammonium hydroxide.



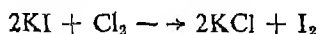
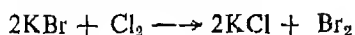
- (ii) bromide gives light yellow precipitate of silver bromide partly soluble in ammonium hydroxide



- (iii) iodides give yellow precipitate, of silver iodide, insoluble in ammonium hydroxide



- (2) Chlorine water test :- In this test, carbon tetrachloride is added to the halide solution. This mixture is then shaken with chlorine water. Bromide gives an orange coloured organic layer (carbon tetrachloride). In this, bromine is liberated. It is absorbed in organic solvent producing orange colour. Iodide produces violet colour in organic layer due to the liberation of iodine.



## Uses of hydrochloric acid

- (i) It is used for cleaning metallic surfaces before tinning and electroplating.
- (ii) It is used in dyeing and tanning industries.
- (iii) Dilute hydrochloric acid is used for hydrolysis of starch to give glucose in large scale.
- (iv) It is used for manufacture of chlorine and as a laboratory reagent.



## Questions

1. What is the difference between hydrogen chloride and hydrochloric acid.
2. Why is hydrogen chloride not collected under water ?
3. Write balanced chemical equations for reactions of hydrochloric acid with
  - (i) zinc
  - (ii) calcium hydroxide
  - (iii) ammonia
  - (iv) sodium carbonate
  - (v) magnesium oxide
4. What is aqua-regia. ? What is the main use of aqua-regia ?
5. You are provided with three test tubes containing solutions of potassium chloride, potassium bromide and potassium iodide. Describe a method to label the tubes.
6. What is the role of carbon tetrachloride in chlorine water test of bromide and iodide ?

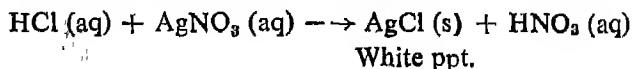
## 10.8 Tests for mineral acids

The three mineral acids used in the laboratory are :

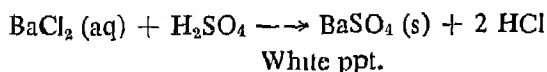
- (i) hydrochloric acid
- (ii) sulphuric acid and
- (iii) nitric acid.

These three acids can be tested as given below :

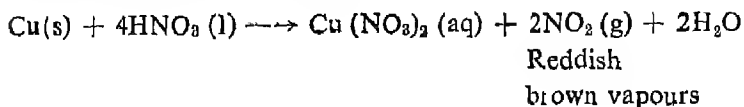
- (i) *Hydrochloric acid* : On adding silver nitrate solution, it gives curdy white precipitate of silver chloride. The precipitates are soluble in ammonium hydroxide.



- (ii) *Sulphuric acid* : On adding a solution of barium chloride, white precipitate of barium sulphate is obtained.

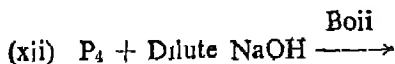
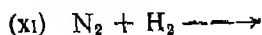
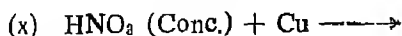
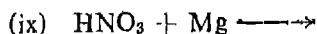
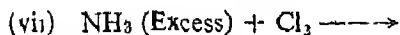
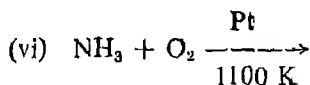
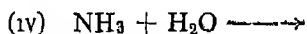
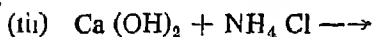
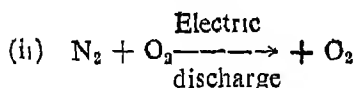


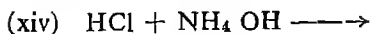
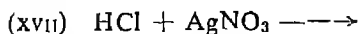
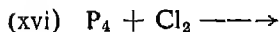
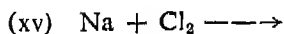
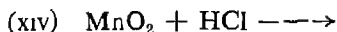
- (iii) *Nitric acid* : On adding copper turnings to a test tube containing concentrated nitric acid, yellowish brown fumes of nitrogen per oxide are evolved.



#### IV. Home Assignment

1. Complete and balance the following reactions :

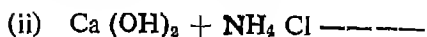
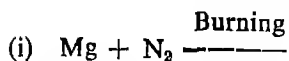


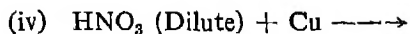
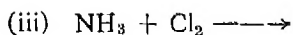


- Using a labelled diagram, explain the laboratory preparation of ammonia gas
- Write the principle of preparation of nitric acid by Ostwald's process.
- List the Oxidising properties of nitric acid.
- How does nitric acid react with alkalis ?
- Explain fountain experiment to show high solubility and acidic nature of HCl gas.
- What happens when a burning piece of magnesium ribbon is taken into a gas jar full of chlorine gas ?
- Draw a labelled diagram used to prepare hydrogen chloride gas in the laboratory.
- Write one test each for chloride, bromide and iodide.
- You are given three bottles containing three liquids. You are told that these contain HCl,  $H_2SO_4$  and  $HNO_3$ . But the bottles are not labelled. Write tests to identify each acid.

## V. Self Assessment

- Complete and balance the following equations :





2. Draw a labelled diagram for the laboratory preparation of ammonia and write the equation for the reaction involved.
3. Sea-water does not contain free nitrogen, Explain.
4. Name two nitrogenous fertilizers.
5. Explain the principle of Haber's process for manufacture of ammonia.
6. Describe an experiment to show high solubility and acidic nature of hydrogen chloride gas

## Teacher's Guide

The main objective of the unit is to familiarize the students with

(a) the position of non-metals (nitrogen, phosphorus and halogens) in the periodic table and

(b) chemistry of these elements and their important compounds. The teacher may discuss the following points in the class at appropriate time,

1. The position of nitrogen and phosphorus may be shown using a periodic table. Their placement in group-V is justified by their electronic configuration
2. Following properties of nitrogen gas may be demonstrated in the class :
  - (i) As a non-supporter of combustion.
  - (ii) Reaction with magnesium ribbon.
  - (iii) neutral behaviour towards acids and alkalies.
3. Discuss the principle of Ostwald's process for the manufacture of nitric acid and demonstrate reactions of nitric acid with magnesium and copper.

**Halogens :** The elements of VII group of the periodic table are called halogens. The teacher may show the position of halogens in periodic table and justify their position in VIIth group on the basis of their electronic configuration. Because of their highly reactive nature, halogens do not occur free in nature. They are found only in the form of their compounds. In this unit, a detailed study of only chlorine and hydrogen chloride has been included.

The teacher may prepare chlorine gas in the laboratory and demonstrate its following properties :

- (i) Colour

- (ii) Solubility
- (iii) Acidic nature and bleaching action.
- (iv) Supporter of combustion with the help of a burning candle or magnesium ribbon and a paper dipped in turpentine.
- (v) Reaction with phosphorus (red).
- (vi) Oxidising action of chlorine gas with  $H_2S$  gas.

Following properties and reactions of hydrogen chloride may be demonstrated in the class :

- (i) Colour
- (ii) Solubility with the help of fountain experiment
- (iii) Acidic nature of hydrogen chloride.
- (iv) Dense white fumes of ammonium chloride by bringing a glass rod dipped in ammonium hydroxide.
- (v) Reaction of hydrogen chloride with a solution of sodium carbonate to form carbon dioxide

Distinguishing tests of halides (chloride, bromide and iodide) and tests of three mineral acids ( $HCl$ ,  $HBr$  and  $HI$ ) may also be demonstrated in the laboratory during the practical periods.

